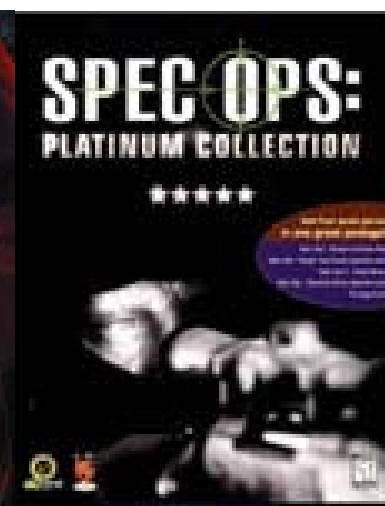
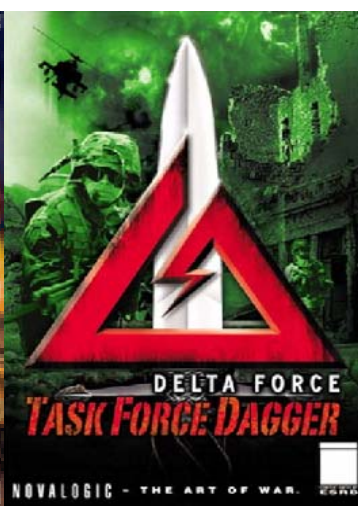
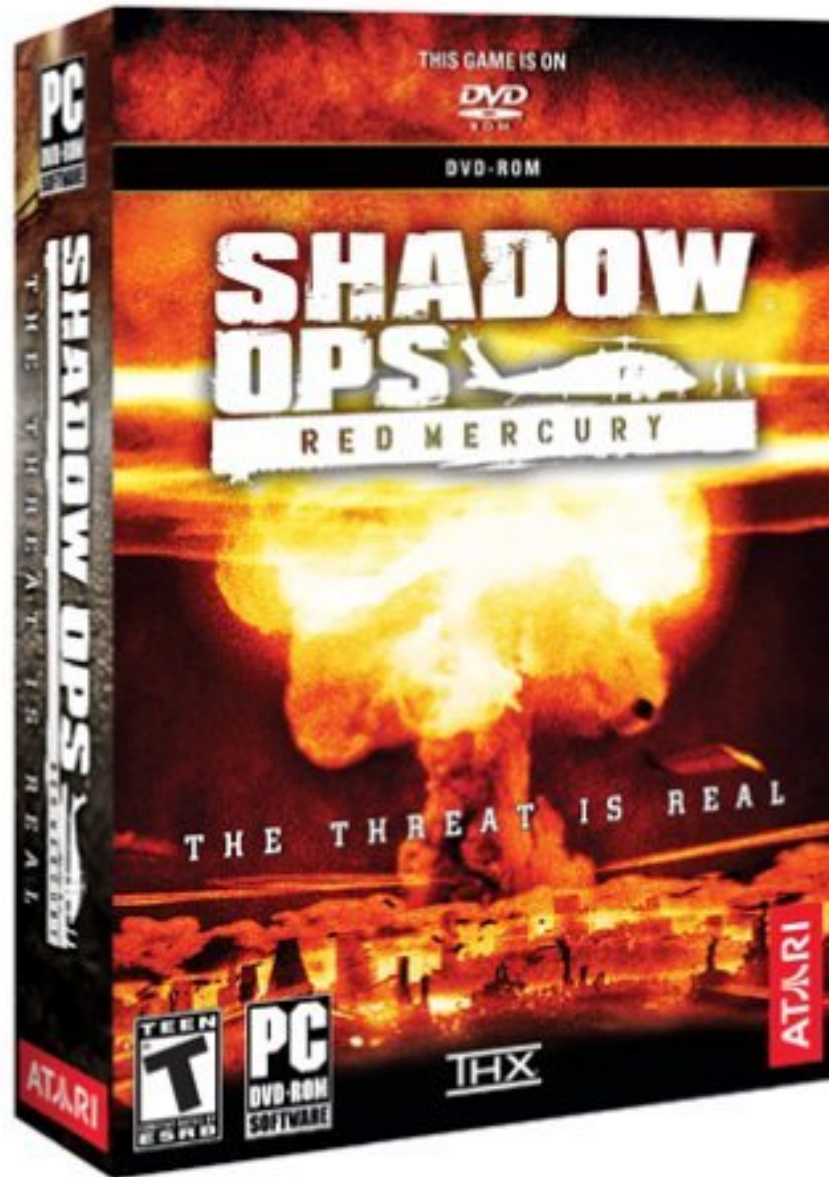




Zombie Studios

Designing and Developing for 64-bit





AMD64 Shadow Ops: Red Mercury



- Increased number of particle effects
- Increased the resolution of light maps
- Increased the number of shaders
- Increased the number of static meshes
- Increased the number of animated meshes
- Increases were up to an order of magnitude



32-bit Version



AMD64 64-bit Version



AMD64 America's Army





Bigger, Faster, Better



- In the last decade CPU designers have achieved performance gains 3 areas:
 - clock speeds – *more cycles*
 - execution optimizations – *more work per cycle*
 - cache – *more fast memory*
- Clock rates have increased 2 orders of magnitude
- Transistor density has increased more than 3 orders

Lots Bigger, Somewhat Faster, Lots Mo' Better



- The clock speed free lunch is over for developers
- Next gen performance gains are going to come from:
 - multithreading – *parallel processing*
 - multi-core – *two or more CPUs on one chip*
 - cache – *cache is king! more on CPU memory*
 - 64-bit processing – *the watershed of performance*

Concurrency is the Next Revolution



- The last revolution – *Object Oriented Programming* – was driven by the increase in size and complexity of games
- OOP's strengths in abstraction and dependency management exploited CPU speeds and memory growth
- The next revolution – *concurrency* – will be driven by the exponential throughput advances of 64-bit CPUs
- Games will increasingly need to be parallelized to exploit 64-bit CPUs

Concurrent “Lock Free” Programming is the New Challenge



- OOP was learning *“What’s an object?”, “How should I use inheritance?”*
- Concurrency is going to be *“What’s a race?”, “What’s a deadlock?”*

So What is a Deadlock?



- Concurrent code runs faster when the threads are independent enough that they don't *reserialize* when they share a resource at execution

The Big Advantage of 64-bit Computing



- 64-bit registers let 64-bit pointers fit into a single register
- The advantage of 64-bit pointers is that they make it possible to address *HUGE* amounts of memory
- 32-bit CPUs are capable of addressing only 2^{32} bytes – *or about 4GB of memory*
- 64-bit processors can theoretically address 2^{64} bytes - *or about 18 billion GBs!*

The Big Benefits of 64-bit Computing



- Computationally intensive programs like games benefit from keeping much larger arrays of data entirely in memory
- That will translate into things like:
 - *massive, contiguous levels/worlds*
 - *more, denser particle effects*
 - *more sophisticated AI*
 - *soft-body physics*
 - *characters with more “bones”*



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